An Historical Perspective of Today's Top Ten (Plus One) Aeromedical Issues

CDR Walt “Lunar” Dalitsch
Director of Specialty Care
Captain James A. Lovell Federal Health Care Center
12 January 2015

Top Ten Plus One Aeromedical Issues

11. CBRNE Operations

1903: Radium Fuel?

RADIUM

EMANATION WATER

Drives Out Uric Acid

Suffering from too much uric acid and diseases caused by faulty elimination—**Rheumatism, Gout, Periodical Headaches, Neuralgia, Constipation, Neurasthenia, Auto-Intoxication and Lack of Bodily Vigor**—quickly relieved in a natural way without drugs or chemicals by our new discovery

THE WAY TO MAKE
RADIUM WATER
IN YOUR OWN HOME

with our Rayode. A little device containing Radium enough to supply 2,700 Mache Units of Radio-activity, in two quarts of water every twenty-four hours, for less than 10c a day. The Rayode will last a lifetime.

SEND FOR FREE LITERATURE

Tells how you can buy or rent a Rayode to make Radium Water in your own home, with your own ordinary drinking water. Address:

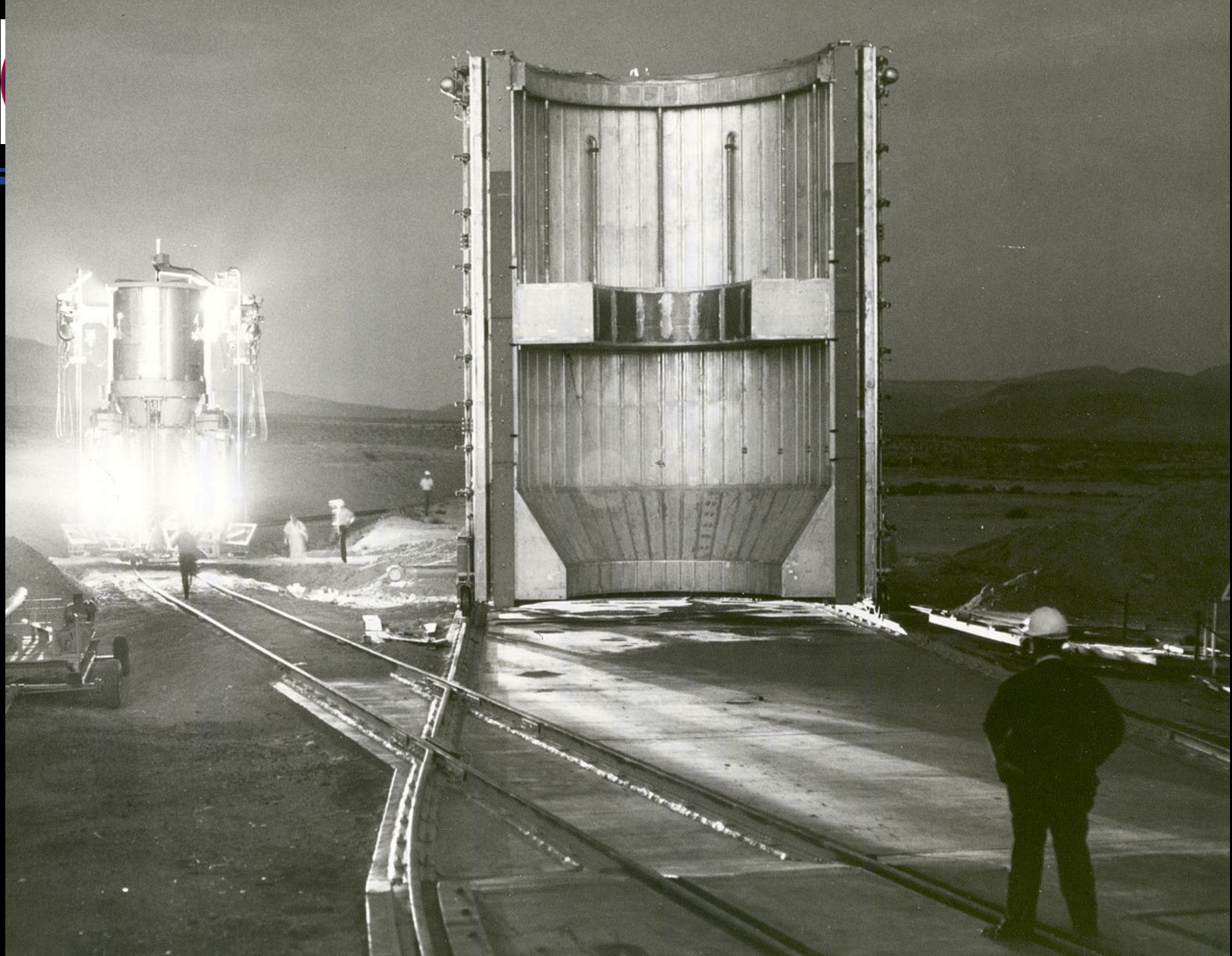
THE COLORADO RADIUM PRODUCTS COMPANY
635 First National Bank Building Denver, Colo

1917: Mustard gas

"Based upon earnest human hopes and the commendable efforts of…the United Nations…one may feel that atomic weapons will be successfully banned…

"[The military assumption is] that it is possible that atomic weapons will be used in the next war!"

- Lt. Col. John Talbot, MC, USA
  October, 1947



2011: Operation Tomodachi

Top Ten Plus One Aeromedical Issues

10. EMALS/Magnetic Environment Exposure
11. CBRNE Operations

"Certain propulsion systems theoretically useful in space vehicles would employ strong magnetic fields in their design... [There is] a need for caution when humans are subjected to a powerful magnetic field."

- Eiselein, Boutell and Biggs
  Lawrence Radiation Lab
  Livermore, California
  May, 1961

1961: No Effect

- 8,800-14,400 gauss
  - Pre-existing tumor growth
  - Growth rate
  - Blood counts
- Contradicted previous studies

78

Top Ten Plus One Aeromedical Issues

9. Hearing Protection and Performance
10. EMALS/Magnetic Environment Exposure
11. CBRNE Operations

"Hearing is not particularly important in the aviator. He needs sufficient hearing to detect the functioning of his motor, but he is deaf indeed who cannot hear that. He also ought to be able to hear his mechanic when he says 'Contact' or 'Switch Off.'"

- Louis H. Bauer
Aviation Medicine, 1926

Top Ten Plus One Aeromedical Issues

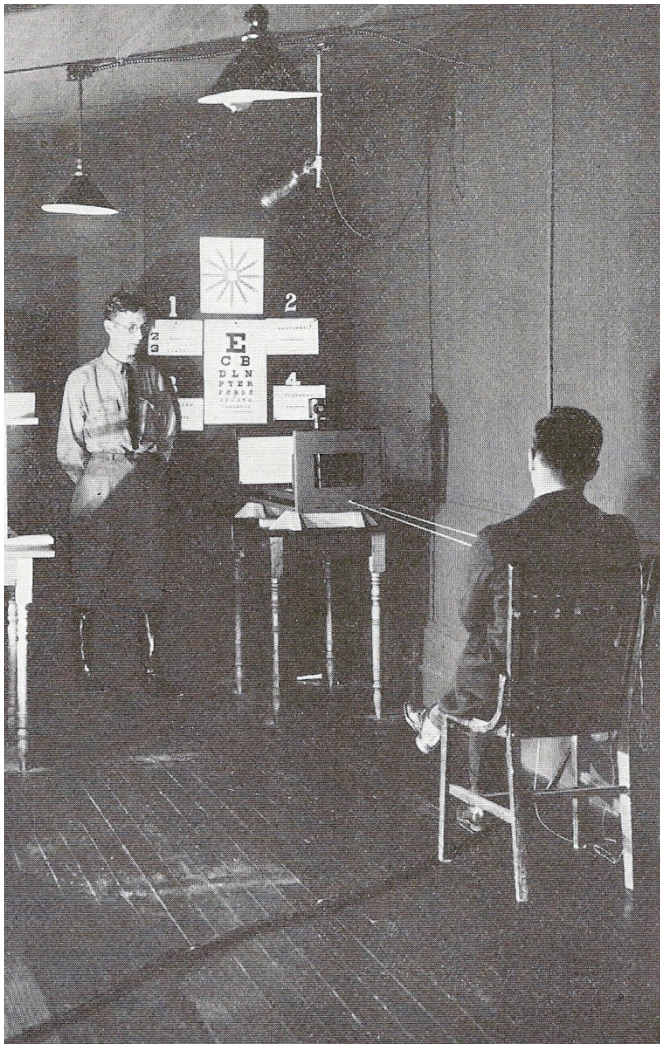
8. Vision Enhancement and Protection
9. Hearing Protection and Performance
10. EMALS/Magnetic Environment Exposure
11. CBRNE Operations

1926: Vision Standards

- Visual acuity
  - Candidate 20/20 by Snellen
  - Trained pilot 20/30 by Snellen

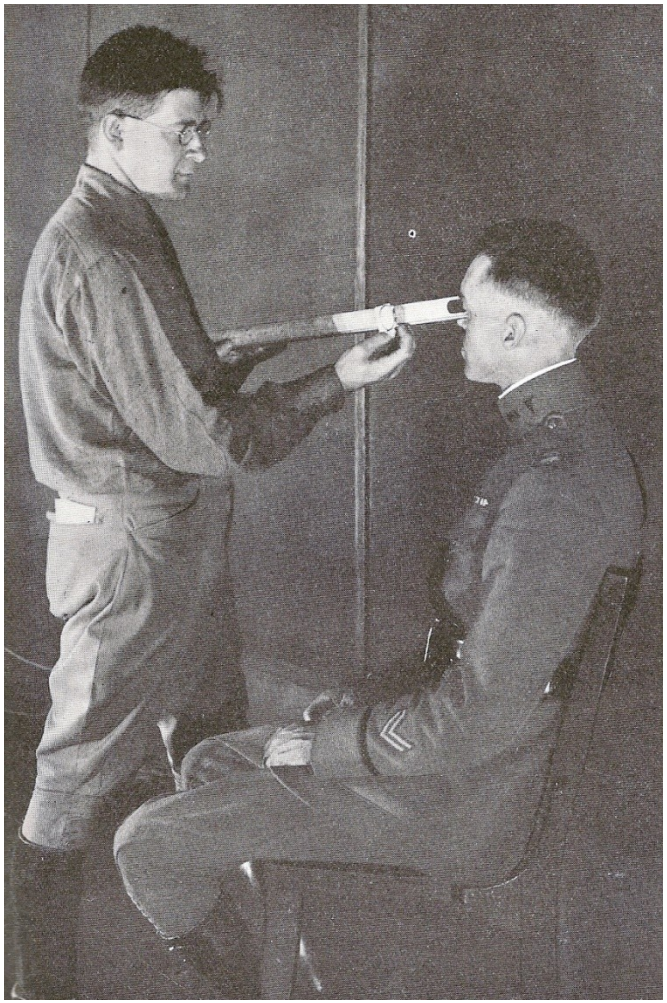
1926: Vision Standards

- Depth Perception
  - Candidate 25 mm
  - Trained pilot 30 mm



1926: Vision Standards

- Accommodation
- Field of vision
- Color vision
- Eye muscle balance
- Night vision



"With any goggle at present available, it is not believed that a correcting lens is satisfactory in the case of a pilot. Correcting lenses restrict the field of vision."

- Louis H. Bauer
Aviation Medicine, 1926

“We no longer need to worry about a large unshapely goggle lens; we can prescribe when indicated a comfortable fitting correction of regular spectacle quality lens and frame.”

- E. H. Padden
  United Airlines, 1936

"Prior to the war, two badges identified the flying cadet. The first was the convertible roadster, preferably equipped with blonde. The second was a pair of flying sun glasses, which he wore without regard to their need. Whether the first contributed to his flying efficiency is questioned by some; there was greater justification for the latter."

- John L. Matthews
  February, 1949

"[C]ontact lenses in their present condition can only satisfy a few ametropes and it does not seem advisable to promote their widespread us among flying personnel."

- Médecin-Lt. Col. Jaques Duguet
  October, 1952

"At the present time, contact lenses for aircrew personnel have a questionable safety factor due to some potential hazards The majority of pilots who wear glasses...would not derive sufficient practical advantage from corneal lenses..."

- Stanley Diamond
  November, 1962

Top Ten Plus One Aeromedical Issues

7. Motion Sickness
8. Vision Enhancement and Protection
9. Hearing Protection and Performance
10. EMALS/Magnetic Environment Exposure
11. CBRNE Operations

1945: Swing Test

"[S]winging in the sitting position through a swing arc of 150 degrees on a swing with a radius of 14 feet from the center of swing to the seat...

"Swinging was continued for twenty minutes or until the subject vomited."

11.3% in the non-airsick; 65.4% in the airsick

"There are several types of motion sickness such as airsickness, seasickness, trainsickness, carsickness, sickness on amusement park devices, sickness in parachute descents, and sickness from riding animals, especially camels."

- Allan Hemingway
  February, 1946

Top Ten Plus One Aeromedical Issues

6. Unmanned Aircraft Systems
7. Motion Sickness
8. Vision Enhancement and Protection
9. Hearing Protection and Performance
10. EMALS/Magnetic Environment Exposure
11. CBRNE Operations

Men vs. Robots

"While it appears practical and advantageous to control airplanes either remotely or automatically in certain limited applications, there is little doubt that we shall have men in most of our high-performance airplanes for many years to come..."

- S. N. Roscoe
  December, 1954

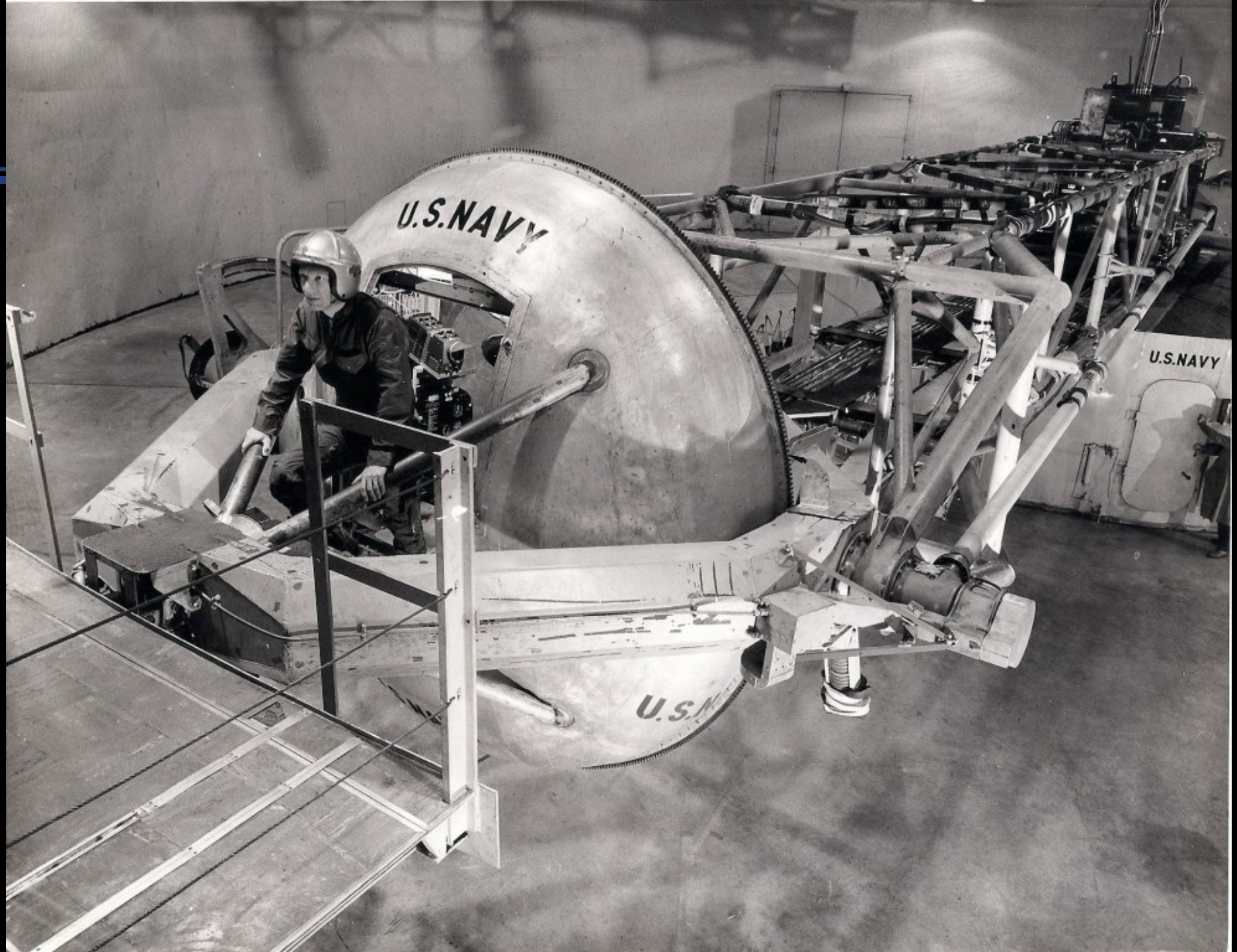
Top Ten Plus One Aeromedical Issues

5. GLOC Prevention
6. Unmanned Aircraft Systems
7. Motion Sickness
8. Vision Enhancement and Protection
9. Hearing Protection and Performance
10. EMALS/Magnetic Environment Exposure
11. CBRNE Operations

Anti-G Suit

John R. Poppen
(1893-1965)

ERROL
FLYNN
FRED
MacMURRAY
in
WARNER BROS.'
THRILLING NEW SAGA
OF THE SKIES!
DIVE
BOMBER
in TECHNICOLOR
RALPH
BELLAMY
ALEXIS
SMITH
ROBERT
ARMSTRONG
REGIS
TOOMEY
ALLEN
JENKINS
Directed by
MICHAEL CURTIZ


U.S.NAVY
U.S.NAVY

Top Ten Plus One Aeromedical Issues

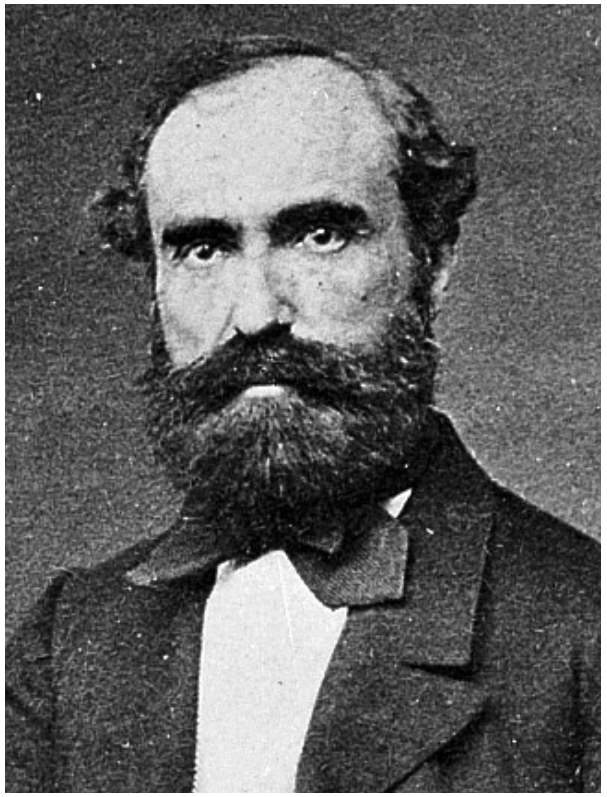
4. Vibration Injury
5. GLOC Prevention
6. Unmanned Aircraft Systems
7. Motion Sickness
8. Vision Enhancement and Protection
9. Hearing Protection and Performance
10. EMALS/Magnetic Environment Exposure
11. CBRNE Operations

Top Ten Plus One Aeromedical Issues

3. Hypoxia and Decompression Sickness
4. Vibration Injury
5. GLOC Prevention
6. Unmanned Aircraft Systems
7. Motion Sickness
8. Vision Enhancement and Protection
9. Hearing Protection and Performance
10. EMALS/Magnetic Environment Exposure
11. CBRNE Operations

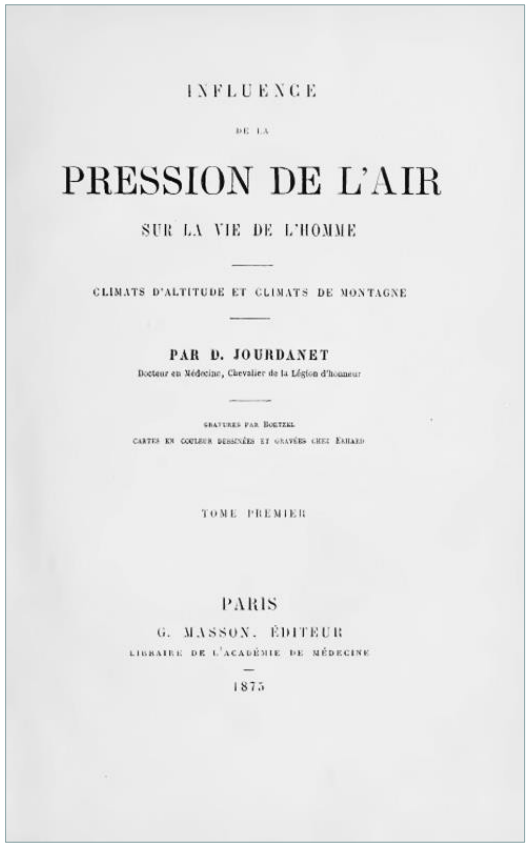
“Discovery” of Hypoxia

Paul Bert
(1833-1886)



Denis Jourdanet
(1815-1892)

“Discovery” of Hypoxia



INFLUENCE

DE LA

PRESSION DE L'AIR

SUR LA VIE DE L'HOMME

CLIMATS D'ALTITUDE ET CLIMATS DE MONTAGNE

PAR D. JOURDANET

Docteur en Médecine, Chevalier de la Légion d'honneur

GRAVURES PAR BOETZEL

CARTES EN COULEUR DESSINÉES ET GRAVÉES CHEZ ERHARD

TOME PREMIER

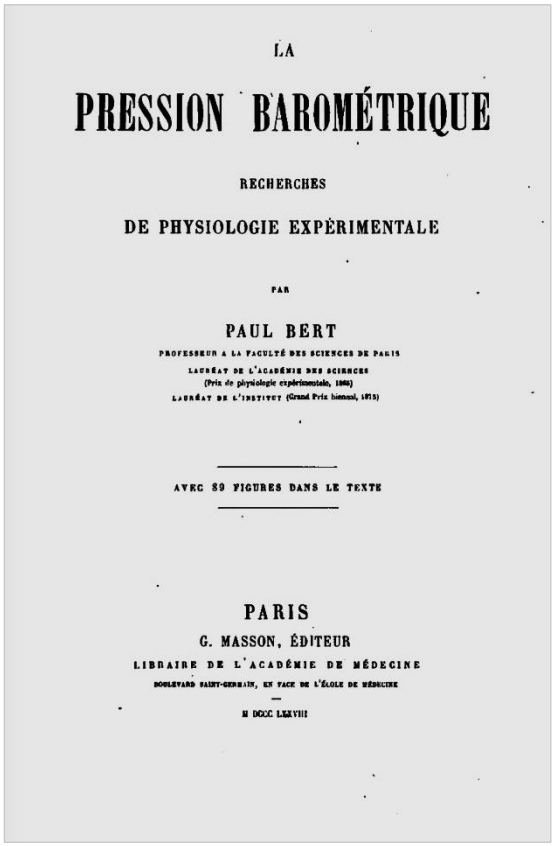
PARIS

G. MASSON, ÉDITEUR

LIBRAIRE DE L'ACADÉMIE DE MÉDECINE

1875

Denis Jourdanet
published 1875



LA

PRESSION BAROMÉTRIQUE

RECHERCHES

DE PHYSIOLOGIE EXPÉRIMENTALE

PAR

PAUL BERT

PROFESSEUR A LA FACULTÉ DES SCIENCES DE PARIS

LAURÉAT DE L'ACADÉMIE DES SCIENCES

(Prix de physiologie expérimentale, 1866)

LAURÉAT DE L'INSTITUT (Grand Prix biennal, 1875)

AVEC 89 FIGURES DANS LE TEXTE

PARIS

G. MASSON, ÉDITEUR

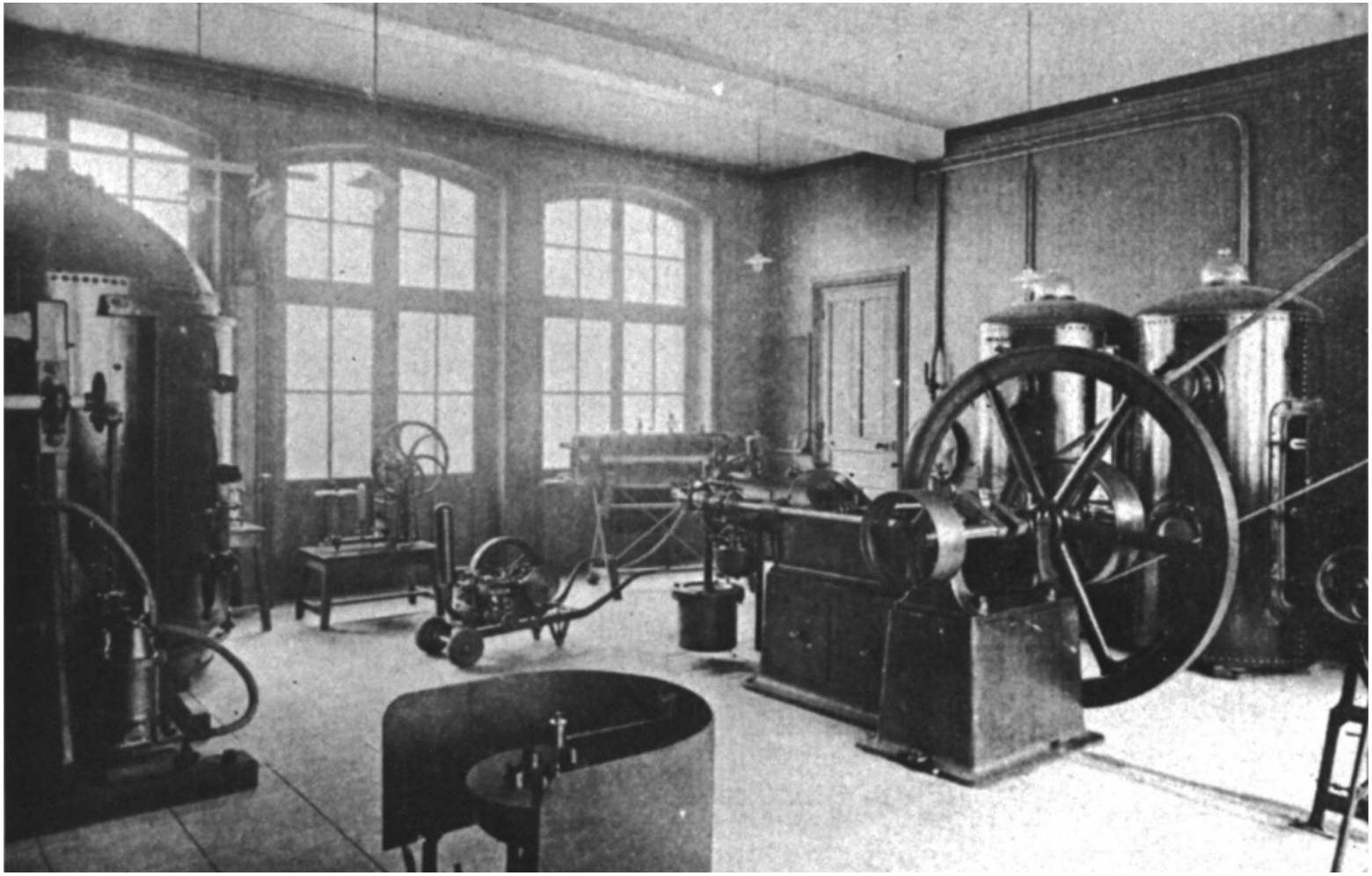
LIBRAIRE DE L'ACADÉMIE DE MÉDECINE

BOULEVARD SAINT-GERMAIN, EN FACE DE L'ÉCOLE DE MÉDECINE

M DCCC LXXVIII

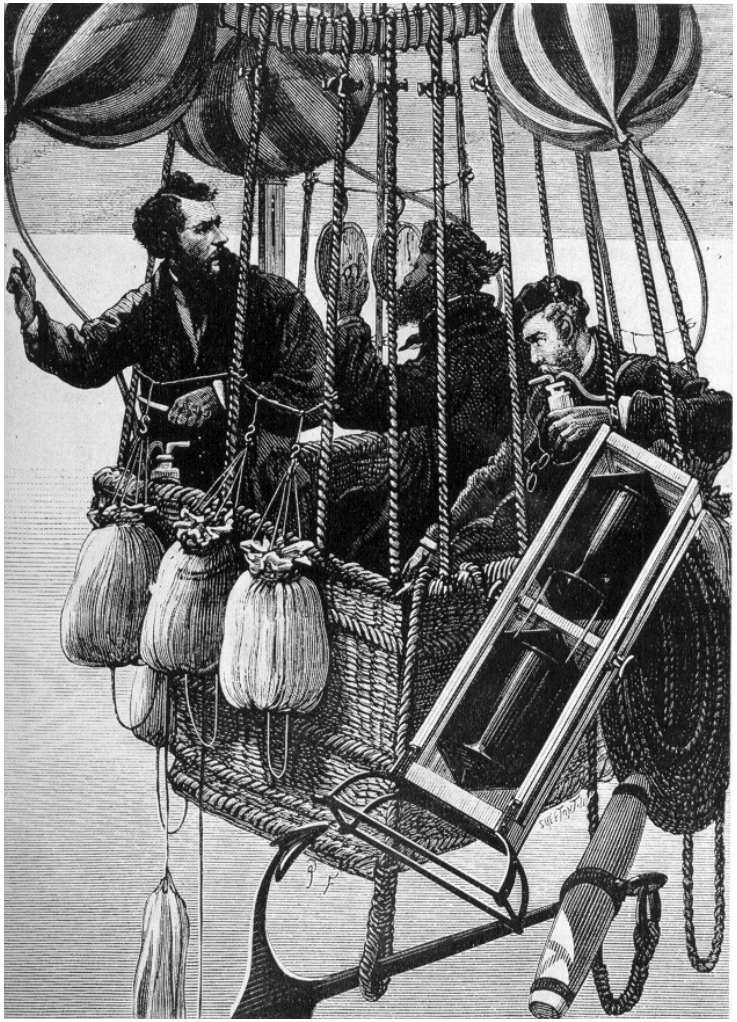
Paul Bert
published 1878

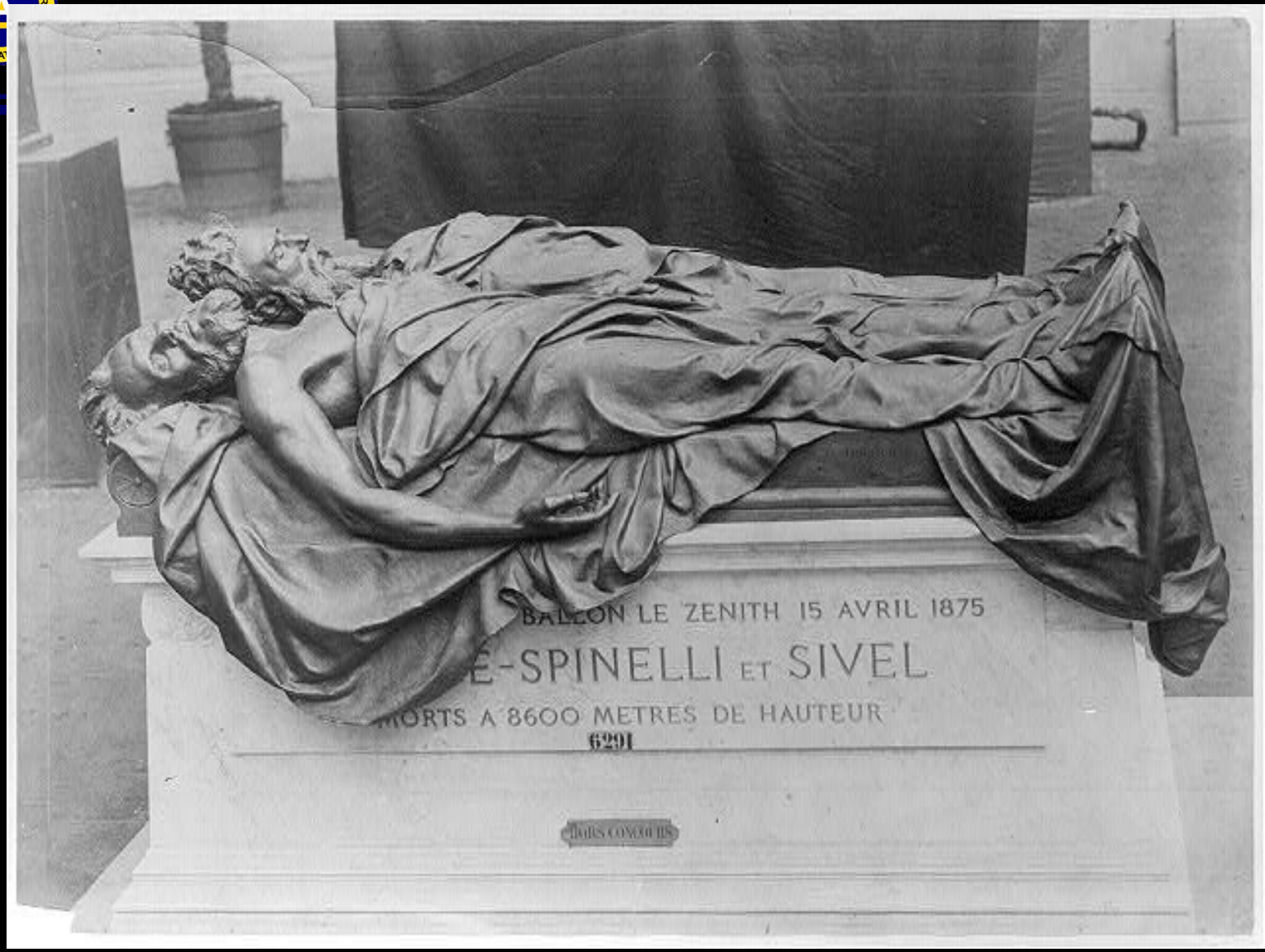
Early Chambers



First Hypoxia Fatalities

- April 15, 1875
- 28,820 ft




BALLON LE ZENITH 15 AVRIL 1875
É-SPINELLI ET SIVEL
MORTS A 8600 METRES DE HAUTEUR
6291

World War I

- Tolerances
  - Class A: no restrictions
  - Class B: <15,000 feet
  - Class C: <8,000 feet
  - Class D: should not fly
- Oxygen required >15,000 feet

First Oxygen Mask

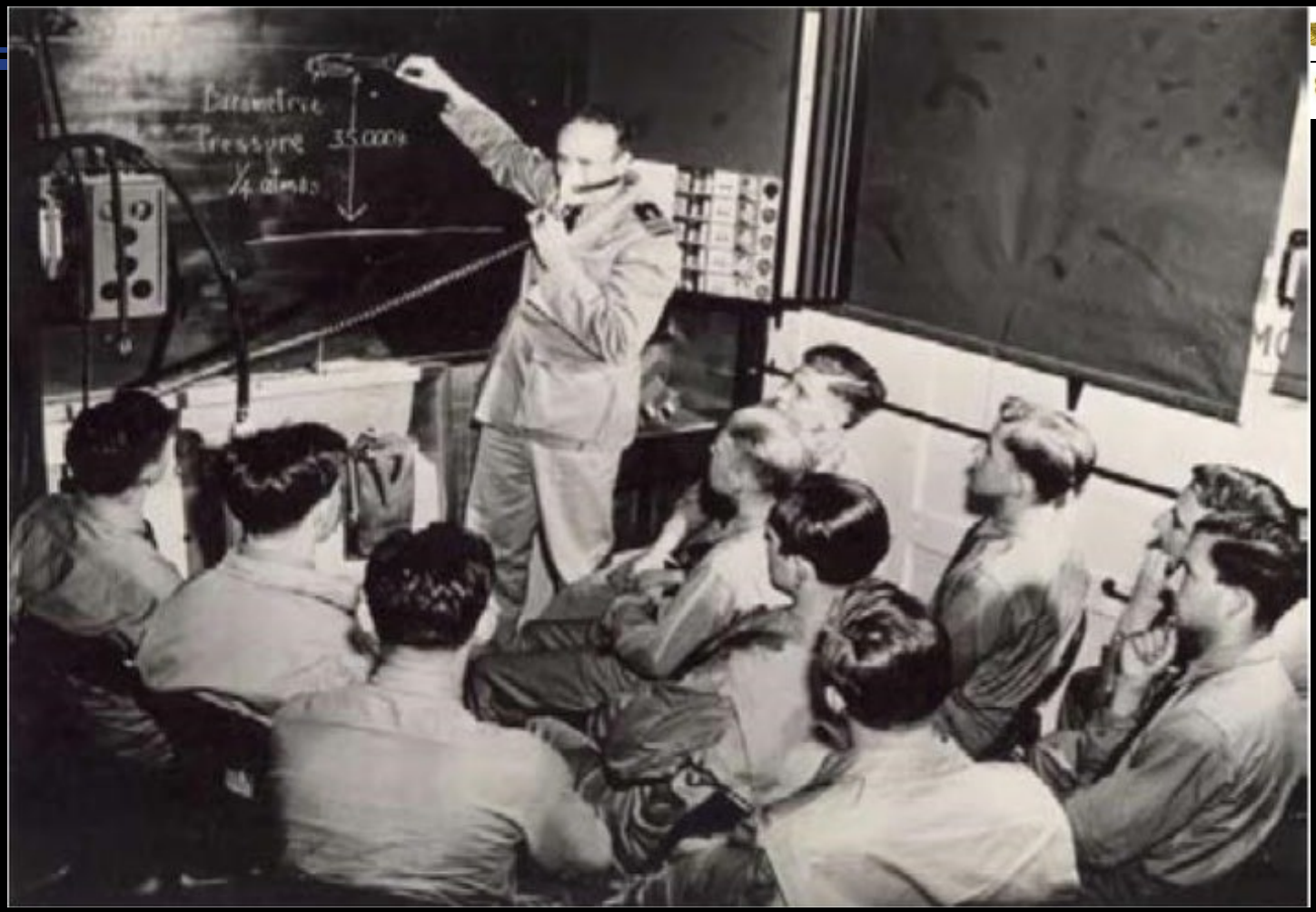
Walter M. Boothby
(1880-1953)

W. Randolph Lovelace
(1907-1965)

Arthur H. Bulbulian
(1900-1996)

BLB oxygen mask

A-14 oxygen mask


Barometric
Pressure 35,000
¼ atmos

Top Ten Plus One Aeromedical Issues

2. Fatigue Operations
3. Hypoxia and Decompression Sickness
4. Vibration Injury
5. GLOC Prevention
6. Unmanned Aircraft Systems
7. Motion Sickness
8. Vision Enhancement and Protection
9. Hearing Protection and Performance
10. EMALS/Magnetic Environment Exposure
11. CBRNE Operations

DIRECTIONS FOR PROCEDURE IN THE CIRCULATORY EFFICIENCY TEST (SCHNEIDER INDEX)

Preliminary: Subject reclines for five minutes.

1. Heart rate is counted for 20 seconds. When two consecutive 20 second counts are the same this is multiplied by 3 and recorded.

TABLE 1

Points for grading cardiovascular changes. (Schneider Index)

A. RECLINING PULSE RATE		B. PULSE RATE INCREASE ON STANDING				
Rate	Points	0–10 beats, points	11–18 beats, points	19–26 beats, points	27–34 beats, points	35–42 beats, points
50–60	3	3	3	2	1	0
61–70	3	3	2	1	0	−1
71–80	2	3	2	0	−1	−2
81–90	1	2	1	−1	−2	−3
91–100	0	1	0	−2	−3	−3
101–110	−1	0	−1	−3	−3	−3

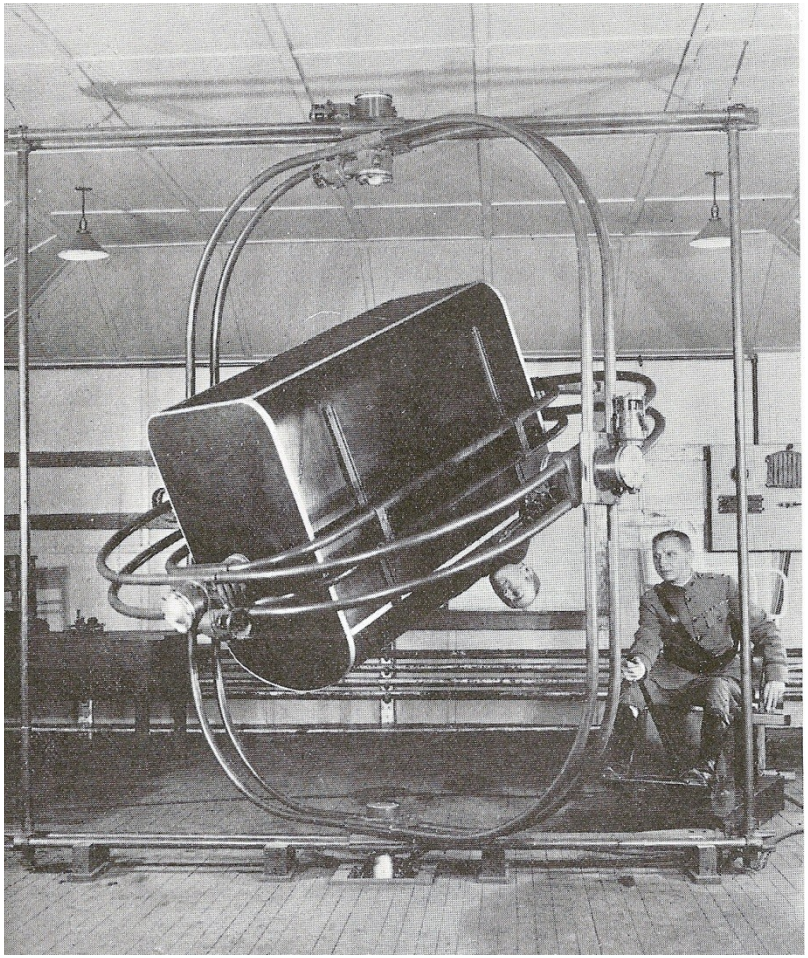
C. STANDING PULSE RATE		D. PULSE RATE INCREASE IMMEDIATELY AFTER EXERCISE				
Rate	Points	0–10 beats, points	11–20 beats, points	21–30 beats, points	31–40 beats, points	41–50 beats, points
60– 70	3	3	3	2	1	0
71– 80	3	3	2	1	0	0
81– 90	2	3	2	1	0	−1
91–100	1	2	1	0	−1	−2
101–110	1	1	0	−1	−2	−3
111–120	0	1	−1	−2	−3	−3
121–130	0	0	−2	−3	−3	−3
131–140	−1	0	−3	−3	−3	−3

E. RETURN OF PULSE RATE TO STANDING NORMAL AFTER EXERCISE		F. SYSTOLIC PRESSURE, STANDING, COMPARED WITH RECLINING	
Seconds	Points	Change in millimeters	Points
0– 30	3	Rise of 8 or more	3
31– 60	2	Rise of 2–7	2
61– 90	1	No rise	1
91–120	0	Fall of 2–5	0
After 120: 2–10 beats above normal	−1	Fall of 6 or more	−1
After 120: 11–30 beats above normal	−2		

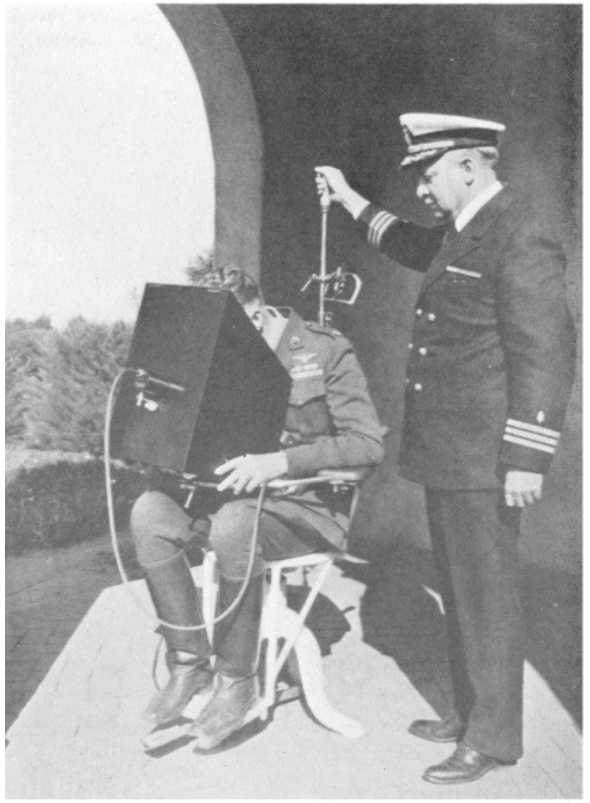
Top Ten Plus One Aeromedical Issues

1. Spatial Disorientation/CFIT Mitigation
2. Fatigue Operations
3. Hypoxia and Decompression Sickness
4. Vibration Injury
5. GLOC Prevention
6. Unmanned Aircraft Systems
7. Motion Sickness
8. Vision Enhancement and Protection
9. Hearing Protection and Performance
10. EMALS/Magnetic Environment Exposure
11. CBRNE Operations

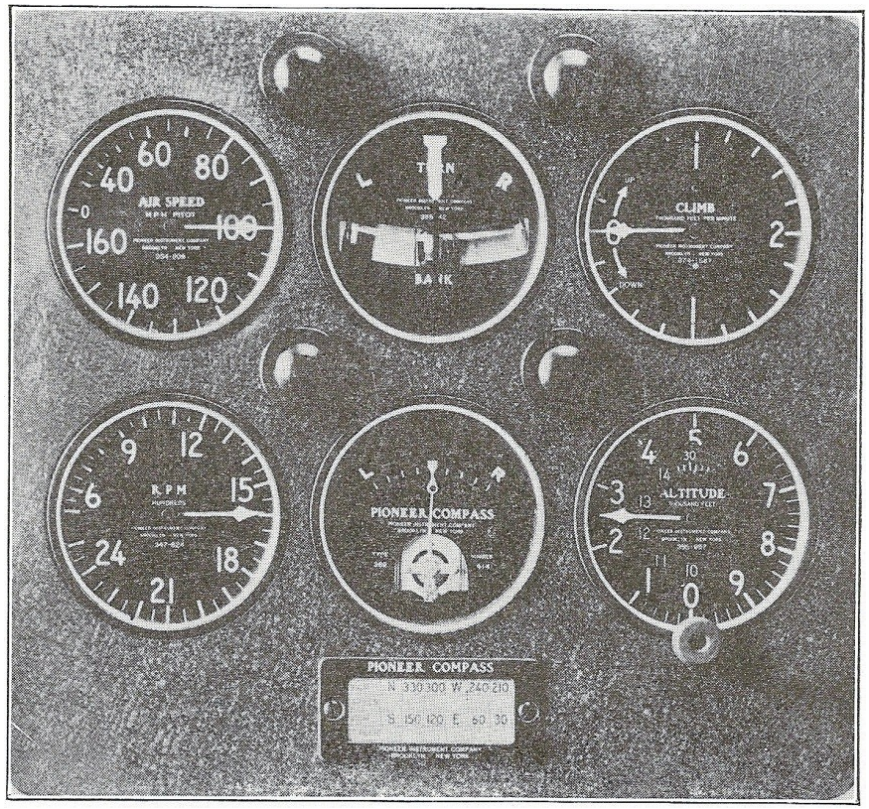
1917: Ruggles Orientator

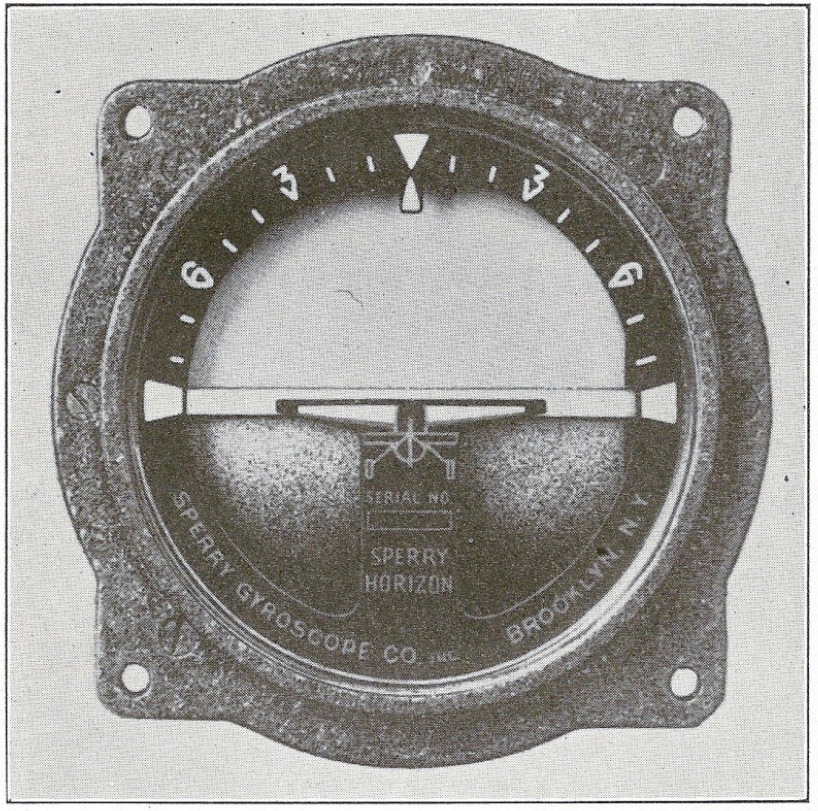


1920s: Vestibular Studies

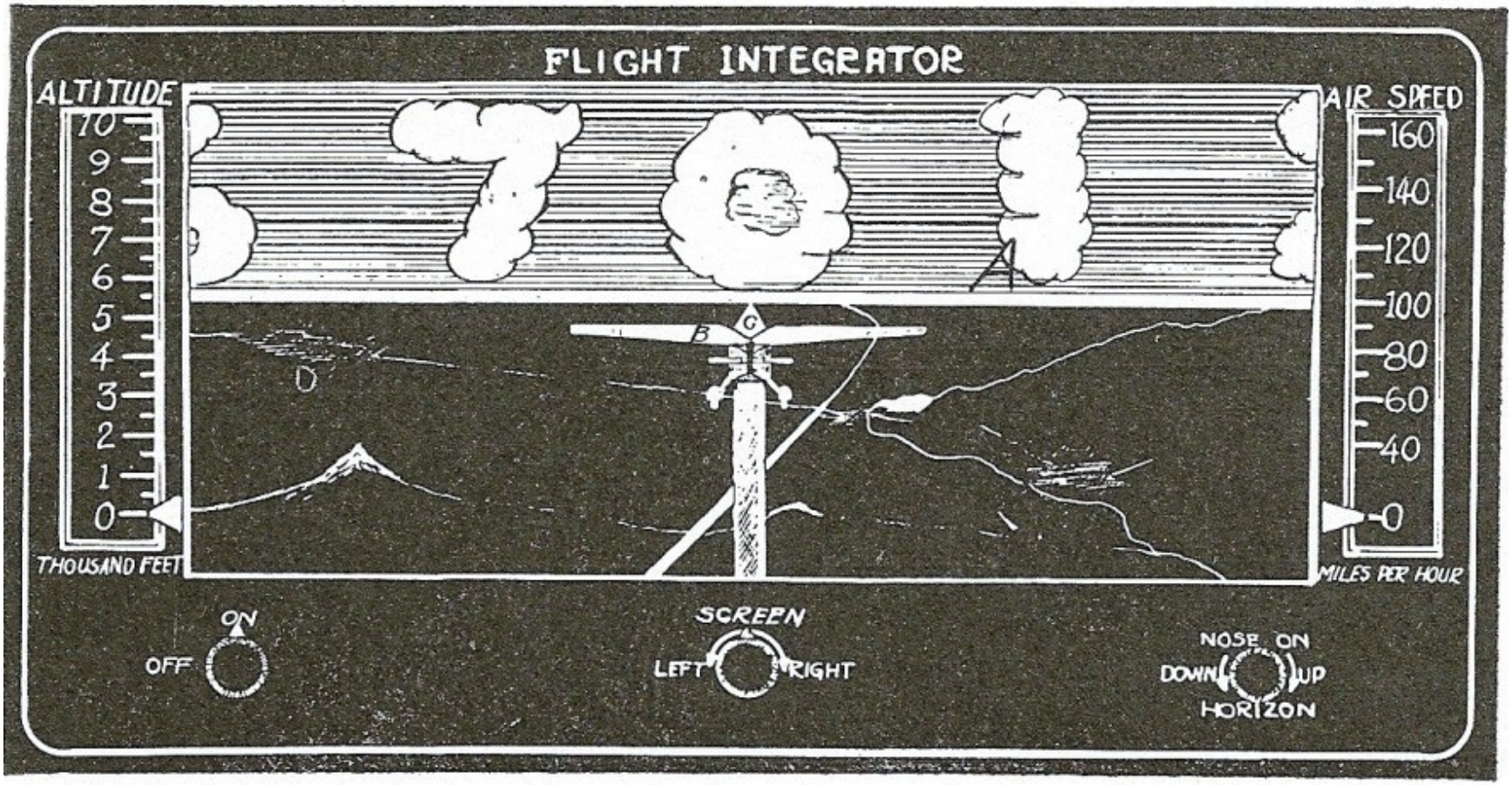


1930: Blind Flying





1932: Flight Integrator



1934: “Three mechanisms”

- Vestibular apparatus
- Somatic senses
- Teleceptive sense – vision

"What a horrible pity that we ever permitted ourselves the habitual use of this expression [blind flying] – the world's worst misnomer. It will take a generation to weed it out. In the words of the familiar vernacular, 'there ain't no such animal!'"

- Lt. Cmdr. John Poppen
  September 29, 1934

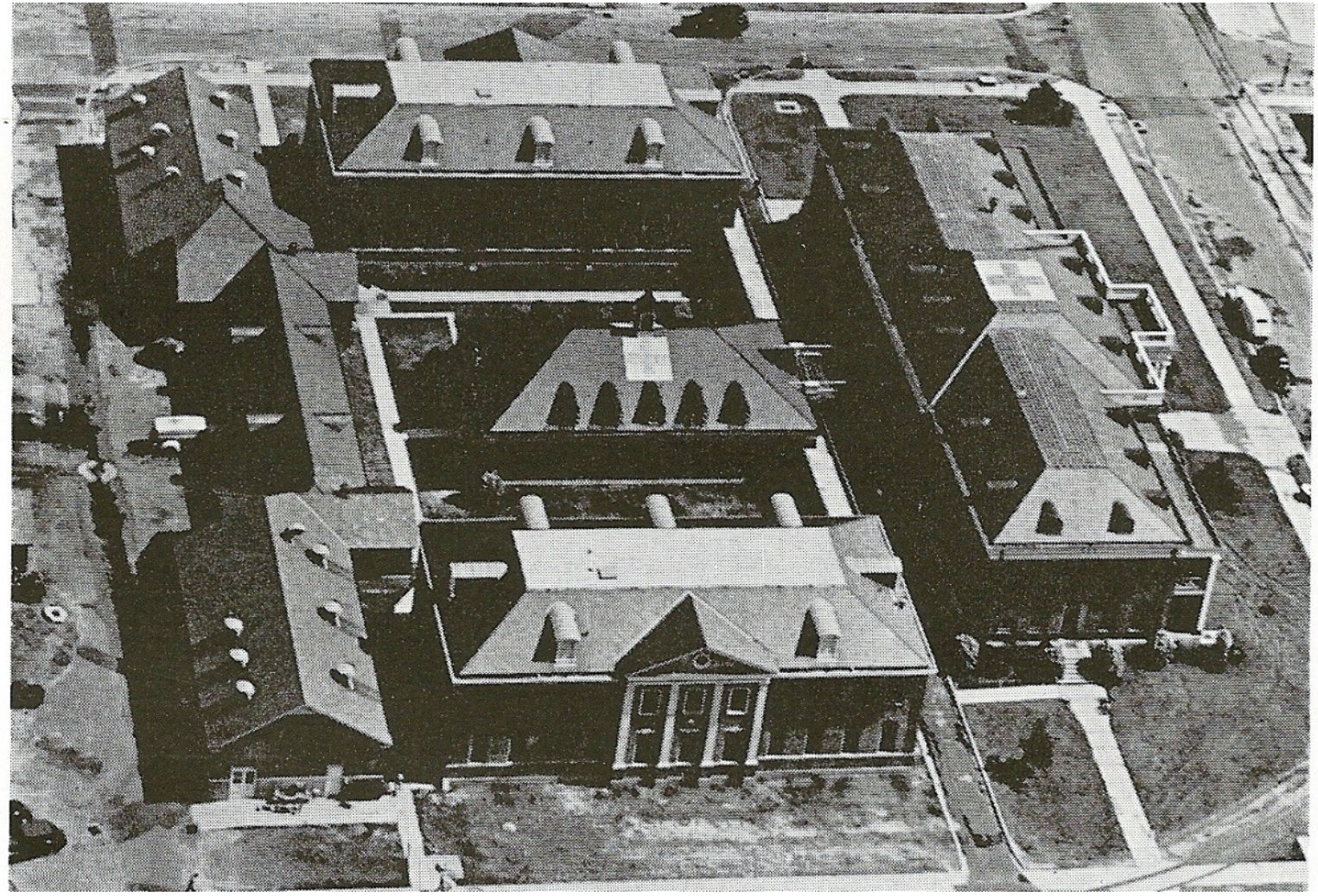
"By disregarding his 'natural' sensations and attending to his instruments, [the pilot] can maintain a safe attitude toward the earth and *by no other means!*"

- Lt. Cmdr. John Poppen
  September 29, 1934

Tactile Situational Awareness System

Angus Rupert
Naval Flight Surgeon

NAMI established 1939



Top Aeromedical Issues in 1941

1. Spatial Disorientation/CFIT Mitigation
2. Fatigue Operations
3. Hypoxia and Decompression Sickness
4. Vibration Injury
5. GLOC Prevention
6. Unmanned Aircraft Systems
7. Motion Sickness
8. Vision Enhancement and Protection
9. Hearing Protection and Performance
10. EMALS/Magnetic Environment Exposure
11. CBRNE Operations

Selection of Aviators

"Unquestionably, those under twenty, while they may learn to fly easily, lack judgment, and are not to be recommended. The optimum age is… from twenty to twenty-eight years… it is doubted whether good combat flyers are ever developed from men who start their flying when over twenty-eight. It is not believed that a man should take up flying after thirty-five… A few years ago, the statement was frequently made that the flyer would not last more than ten to fifteen years. In the case of the flyer with a sound makeup, who takes good care of himself, that limit may be extended, but in the cases of others, there would seem to be no grounds for extending it."

Weight Standards in 1926

TABLE 1

Standards for all applicants except Filipinos

A STANDARD ACCEPTED MEASUREMENTS				B THE FOLLOWING VARIATIONS FROM THE STANDARD SHOWN IN COLUMN A ARE PERMISSIBLE WHEN THE APPLICANT IS ACTIVE, HAS FIRM MUSCLES, AND IS EVIDENTLY VIGOROUS AND HEALTHY			
Height	Weight	Chest measurement		Height	Weight	Chest measurement	
		At expiration	Mobility			At expiration	Mobility
inches	*pounds*	*inches*	*inches*	*inches*	*pounds*	*inches*	*inches*
64	128	32	2	64	120	30	2
65	130	32¼	2	65	121	30	2
66	132	32½	2	66	122	30¼	2
67	136	33	2	67	124	30½	2
68	141	33¼	2½	68	126	30¾	2
69	148	33½	2½	69	128	31	2
70	155	34	2½	70	130	31¼	2
71	162	34¼	2½	71	133	31¾	2
72	169	34¾	3	72	138	32¼	2½
73	176	35¼	3	73	143	32¾	2½
74	183	36	3	74	148	33½	2½
75	190	36¾	3¼	75	155	34¼	2¾
76	197	37¼	3½	76	161	34¾	2¾
77	204	37¾	3¾	77	168	35¼	3
78	211	38¼	4	78	175	35¾	3

References

Archives of the journal (various titles) of the Aerospace Medical Association, 1930 ff.

Armstrong HG. *Principles and Practice of Aviation Medicine*. Williams & Wilkins: Baltimore, 1939.

Bauer LH. *Aviation Medicine*. Williams & Wilkins: Baltimore, 1926.

Bauer LH. *Aviation Medicine*. Oxford: New York, 1943.

Blum D. *The Poisoner's Handbook*. Penguin: New York, 2010.

Ocker WC, Crane CJ. *Blind Flight in Theory and Practice*. Naylor: San Antonio, 1932.

Personal notes and historical aviation and aviation medicine book collection.

Various writings of giants (Paul Bert, Isaac Jones, Louis Bauer, John Poppen, Harry Armstrong).

Questions?

CDR Walt “Lunar” Dalitsch

Director of Specialty Care

Captain James A. Lovell Federal Health Care Center

walter.dalitsch@va.gov

(224) 610-3050